RFID Laptop Monitoring and Management System

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Abstract— This paper describes the design of an RFID Laptop Monitoring and Management system. Laptops embedded with RFID chips are monitored and tracked to provide a monitoring system for the purpose of tracking as well as monitoring movement of the laptops in and out of a building. The proposed system is implemented with both hardware and software components. The hardware architecture consists of RFID passive tag, RFID module (reader), and a server hosting the application and database.

The RFID readers are distributed at major exits of a building or premises. The tags are programmed with owner laptop details are concealed in the laptops. The software architecture consists of an application software that has the APIs (Applications Programming Interface) necessary to interface the RFID system with the PC, to achieve automated laptop monitoring system. A friendly graphic user interface (GUI) and a database that saves all readings and owners details. The system is capable of reducing laptop theft especially in student' hostels as laptops can be monitored as they are taken either in or out of the building.

Keywords— Asset tracking, GUI, Laptop Monitoring, **Radio Frequency Identification (RFID),** Passive Tags

I. INTRODUCTION

RFID is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. [1] RFID systems have been used widely in asset monitoring. This application can lead to significant reduction on asset theft and provide a constant record update monitored assets in a building. [2]

The information contained on microchips in the RFID tags affixed to assets and is read using Radio frequency technology regardless of item orientation or alignment.

Radio frequency identification (RFID) is an automatic identification system like barcode, smart cards etc. Which helps machines in identifying objects. It consists of a transponder or a tag, which has an embedded integrated circuit (IC) and an antenna. The IC is encrypted with a unique electronic product code. The antenna allows the tag to receive and respond to radio frequency quires from RFID transceiver. It thus, transmits the data stored in its IC to the receiver, which in turn sends it to a central computer for processing.

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RFID system consists of three components in two combinations: a transceiver (transmitter/receiver) and antenna are usually combined an RFID reader. A transponder (transmitter/responder) and antenna are combined to make an RFID tag.

Table 1: RFID FREQUENCY RANGE AND APPLICATIONS [3] [4**]**

Frequency range	**Description**	**Typical application**
<135KHz	Low Frequency	Access control
13.56MHz	High Frequency,	Access Control, Library books
868-870MHz 902-928MHz	Ultra High Frequencies (UHF)	Supply chain
2.40-2.483GHz	Super High Frequency (SHF)	Asset tracking, highway toll tags, vehicle tracking

UNITS
KHz- Kilo Hertz MHz- Mega Hertz GHz- Giga Hertz

II. SYSTEM FUNCTIONAL REQUIREMENTS

A. Hardware Requirement:

- RF readers able to communicate with the administrative system using Universal serial Board (USB)
- RF passive tags that are minimally affected by metals integrated into the laptops

B. Reading and Measurement

The system will provide the administrator with the tag ID information detected at anytime passing an interrogation zone.

C. Detecting the Laptop:

The system shall be able to detect the laptop if it is within the range of the reader.

D. Interface Requirement:

The system shall have an application programming interface that will open USB port between the reader and the PC.

The system shall contain a graphical user interface that allows the administrator to:

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i. Register all incoming RFID tagged laptops (update the database)
ii. Check in as well as check out a tagged laptop when it taken out and brought back in the building. (query database)
iii. Set alarm for a tagged laptop reported missing
iv. Give event logs of the tagged laptops that have passed though the reader
v. Delete users from its database when the need arises.

III. SYSTEM HARDWARE REQUIREMENT

The RFID tag, tag reader , the monitoring system and database were selected to meet the above stated functionalities. Fig. 1 shows the hard ware architecture.

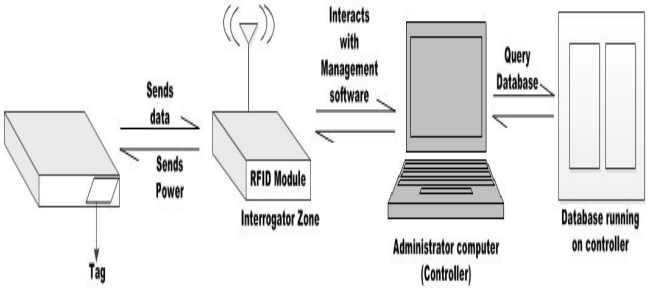

Fig. 1 Hardware architecture

IV. SOFTWARE ARCHITECTURE

RFID laptop monitoring and management system software is created to provide the interactivity between the smart labeled laptops and the hardware: RFID readers and tags. Data processing, database systems, event logs are all performed by the software on getting signals and information from the RFID system. The program is developed for Microsoft windows based systems and its interfacing with the reader. The program is written in C# using Microsoft Visual Studio as work station and the database language used will be SQL (Structured Query Language) using MySQL.
Fig. 2 is the use case diagram that depicts the basic operation of the system that can be carried out by the administrator.

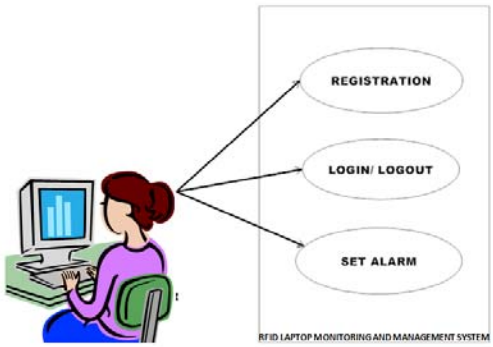

Fig. 2 Software architecture

V. SYSTEM DESIGN

Figure 3 shows the communication between the RFID tag and RFID Reader. The reader acts like a transducer which receives the Radio Frequency signal from the tag and displays the data contained in the tag on the PC containing the management software.

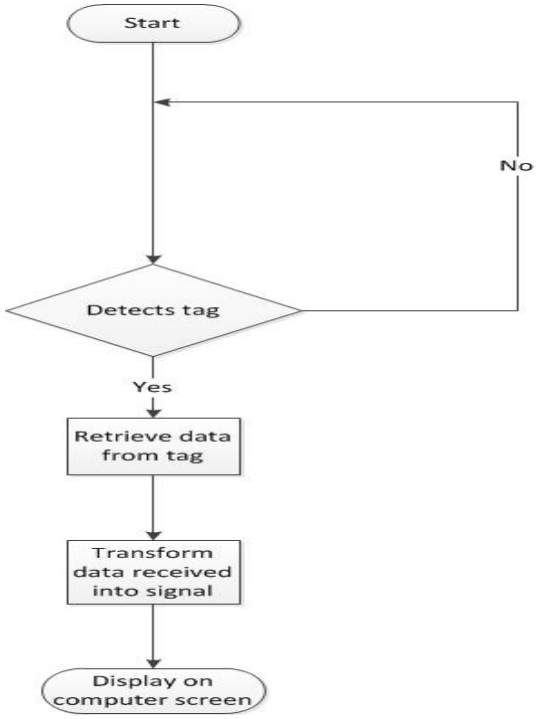

Fig. 3: Flow chart of the communication between the reader and tag

Figures 4 to 7 display the sequence through which the management software carries out its operational function as stated in the use case diagram in fig. 2

Fig. 4: Registration Flow Chart

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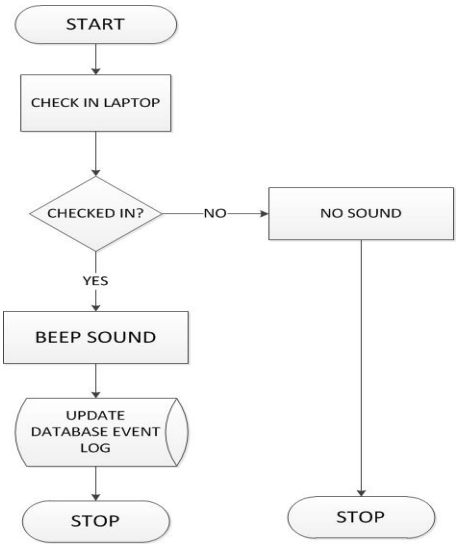

Fig. 5: Check in flow chart

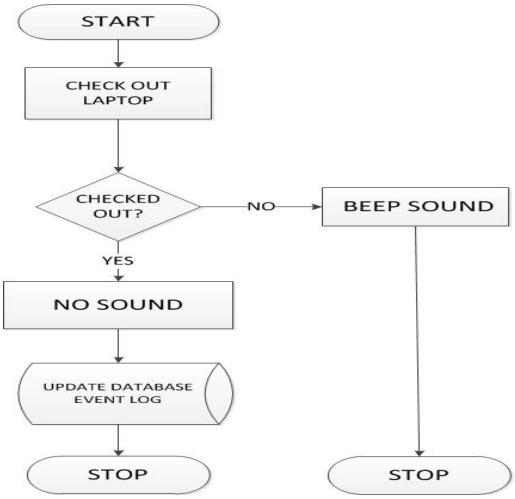

Fig. 6: Check out flow chart

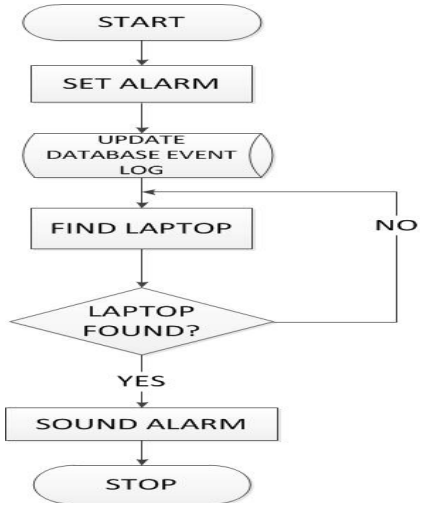

Fig. 7: Alert Flow chart

VI. SYSTEM IMPLEMENTATION

Figure 7 through 9 are the Screen shots of the front end of the management system software.

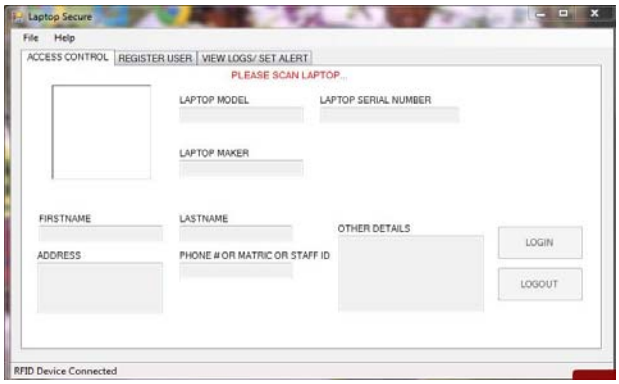

Fig. 8: Default screen display

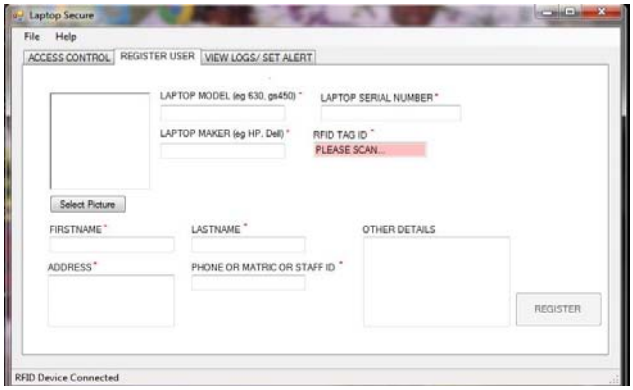

Fig. 9: Registration interface

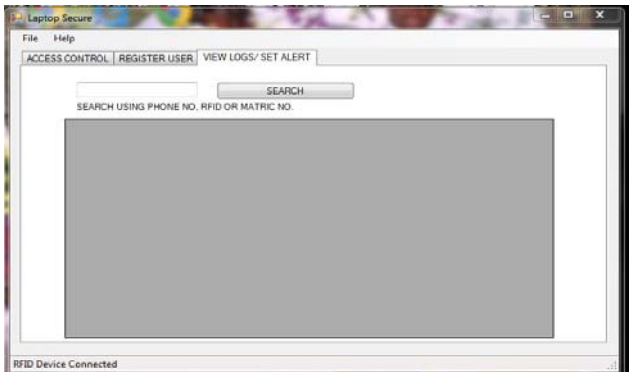

Fig. 10: Event log/alert interface

VII. TESTING

When a tag goes through the interrogation zone (passes the RFID reader), the hexadecimal number of the tag is obtained and the system confirms validity of the tag. The information contained is displayed on the access control interface. The registration interface is where the details of the owner are inserted when it does not exist on the database by the administrator. Figure 13 shows the event log interface, these interface holds the timestamps of the various tagged laptop passing through the interrogation zone.

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In this interface, the administrator can search for a particular laptop using a unique identity either the matriculation number or the phone number of the owner. The administrator can also set an alert if a laptop is reported missing and the owner exist on the database, by clicking on the checkbox.

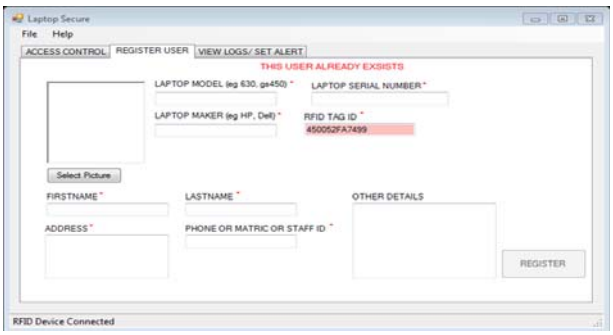

Fig. 11: Passing a registered laptop

Fig. 12: Passing an unregistered tagged laptop

Fig. 13: The details of a tagged laptop user

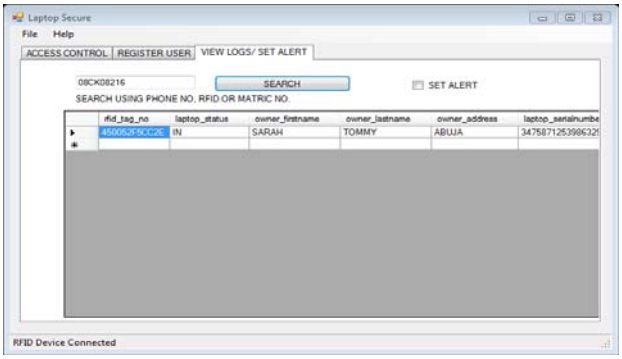

Fig. 14: Search, event log and alert interface

VIII. Conclusion

The system has been able to monitor and track laptops with embedded RFID tags. This reader has been shown to be able to identify the tags embedded in laptops provided that they are not shielded by metals. The system when deployed is capable of providing real time campus wide monitoring of the laptops.

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